

# New and old species of Malaconothroidea from Europe

(Acari, Oribatida)

Gerd Weigmann

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The species *Trhypochthonius tectorum*, *T. nigricans*, *T. cladonicola* (Trhypochthoniidae), *Mucronothrus nasalis* (Mucronothridae) and *Trhypochthoniellus longisetus* (Trhypochthoniellidae) are redescribed. The description of *Trhypochthonius sphagnicola*, spec. nov. is presented, which is similar to *T. nigricans*. A new genus of Trhypochthoniidae, *Altrhypochthonius* Weigmann, 1997 has been established recently for *Trhypochthonius badius*, which is redescribed also. The European species *Trhypochthoniellus crassus*, *T. excavatus* and *T. trichosus* are regarded as junior synonyms to the typical form of *T. longisetus*. *T. setosus* is regarded as a special form without sensilli of *T. longisetus*, having an intrasubspecific taxonomical status: *T. longisetus* forma *setosus*. Within a mixed population of both forms different intermediar and asymmetric specimens have been found.

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## Introduction

The phylogenetic relations of the widely distributed genera *Trhypochthonius* and *Trhypochthoniellus* have not been cleared up in the last decades though van der Hammen (1956) "drew attention to the fact that studies of the genera *Trhypochthonius* and *Trhypochthoniellus* are still badly needed in order to arrive at a firmly defined diagnosis of the family" Trhypochthoniidae Willmann, 1931. Van der Hammen planned a revision of the genera but published some remarks on this item only (1956, 1959). Knülle (1957) clarified the relations between *Trhypochthonius*, *Trhypochthoniellus*, *Malaconothrus* and *Trimalaconothrus* and proposed three distinct families (Trhypochthoniidae, Trhypochthoniellidae and Malaconothridae), but subsequent taxonomists (cp. Gilarov & Krivolutsky 1975, Balogh & Mahunka 1983) did not follow him by leaving *Trhypochthonius*, *Trhypochthoniellus* and *Mucronothrus* in a single family Trhypochthoniidae (in this contribution I will deal with European genera only). Kunst (1971) established a new family Mucronothridae within his keys, without indicating it as new and without an explicit definition; this family has been ignored by subsequent authors. Main difficulties of a phylogenetic analysis resulted from insufficient descriptions of the type species (and others) of the mentioned genera, besides *Malaconothrus* and *Trimalaconothrus* (cp. Knülle 1957).

It is the main task of this contribution to present redescriptions of important European species, including the type species, of *Trhypochthonius*, *Trhypochthoniellus* and *Mucronothrus*. These revisions led to a new phylogenetic analysis on the families and the genera (Weigmann 1997a), a new genus (*Altrhypochthonius* Weigmann, 1997) and a new species (*Trhypochthonius sphagnicola*, spec. nov.).

The mentioned families have been included into the Crotonioidea (= Nothroidea auct.) by most of the taxonomists, but Haumann (1991) separated the Malaconothroidea (as "Trhypochthonioidea"), including the families and genera this paper deals with.

In the following descriptions the numbers of symmetric paired elements are mentioned for one side each (e.g. 6 genital setae = 6 setae on each genital plate).

### *Trhypochthonius Berlese, 1904*

*Tumidulous* Ewing, 1908  
*Trilohnannia* Willmann, 1923

**Type species:** *Hypochthonius tectorum* Berlese, 1896

**Diagnosis.** Well developed bothridia near the lateral margins of prodorsum with well developed sensilli; exobothridial setae reduced or at most one pair vestigial; 15 pairs of notogastral setae, in most of the species bacilliform and ciliated (16th pair of setae ( $f_1$ ) vestigial or missing); on genital plates with 6-18 genital setae in a median row each; 1 pair of anal setae, 3 pairs of adanal setae; subcapitulum stenarthric, with 1 pair of vestigial  $m$ -setae; nearly complete leg setation (e.g. setal and solenidial formula of genua of legs I-IV: 5(+1)-5(+1)-3(+1)-3(+0); tibia I with 2 solenidia,  $w_2$  of tarsus I in median high position near  $w_1$ ; legs tridactyl).

### *Trhypochthonius tectorum* (Berlese, 1896)

Fig. 1

*Hypochthonius tectorum* Berlese, 1896  
*Nothrus tectorum*: Warburton & Pearce (1905)  
*Trhypochthonius tectorum*: Berlese (1904)

**Descriptions.** Willmann (1931), Balogh & Mahunka (1983), Seniczak (1992)

**General characters.** Total length 580-775  $\mu\text{m}$  (greatest of the palaearctic species), cuticula brown. Prodorsum. Cuticula punctulated; prodorsal setae long (70 to >100  $\mu\text{m}$ ), strait, ciliated; lamellar setae the thickest, rostral setae the thinnest; without exobothridial setae; sensilli long, >70  $\mu\text{m}$  with ciliated clavate head (Figs 1b, c).

Notogaster. 15 pairs of notogastral setae well developed, bacilliform and ciliated,  $f_1$  vestigial;  $c_1$ ,  $d_1$ ,  $d_2$  the shortest notogastral setae (>12  $\mu\text{m}$ ); all other dorsal notogastral setae long (about 50-80  $\mu\text{m}$ ); setae  $h_1$  inserted much more backwards than  $h_2$  and  $h_3$ , as also in other Malaconothroidea; cuticula coarsely granulated in posterior and lateral regions, in anterior region appearing netlike; with lateral carina from  $c_3$  to about  $e_3$ ; normal number and positions of lyrifissures; opisthosomal gland near  $f_2$  (Fig. 1a).

Ventral region. Complete epimeral setal formula 3-1-3-3; notogaster builds a frame partly overfolding the genito-anal region, behind the anal plates the frame continuous as longitudinal folds, between which is a flat groove without the coarse structure of the notogaster (Fig. 1d).  $ps$ -setae of medium length (20-60  $\mu\text{m}$ , increasing length from  $ps_3$  to  $ps_1$ ). 10-11 pairs of genital setae (variability not studied!); 3 pairs of adanal setae, 1 pair of anal setae (one studied specimen with 2  $an$  at one side only). Normal pattern of lyrifissures:  $ips$ ,  $iad$ ,  $ian$ .

Gnathosoma. Subcapitulum stenarthric, setae  $h$  and  $a$  long, 1 pair of vestigial setae  $m$ ; rutellum atelebasic, palpal setation (solenidium in parenthesis): 0-1-1-2-9(+1), two pairs of setae on palp tarsus are eupathids. (very similar *T. sphagnicola*, spec. nov., cp. fig. 4a).

Legs. with the most complete setation within the superfamily (as *T. sphagnicola*, spec. nov., cp. fig. 5). The setation formulas of legs are (solenids additional given in parenthesis):

leg I:	1	-	6	-	5(+1)	-	5(+2)	-	16(+3)
leg II:	1	-	6/7	-	5(+1)	-	5(+1)	-	13(+2)
leg III:	2	-	4	-	3(+1)	-	3(+1)	-	12
leg IV:	1	-	2	-	3	-	3(+1)	-	12

Knülle (1957: 149) reports, that often F II has only 6 setae. The legs are tridactylous.

**Discussion.** *T. tectorum* seems to be variable in respect of total length. Balogh & Mahunka (1983) give the range of 660-775  $\mu\text{m}$ ; own material from Northern Germany and studied material from Austria (leg. H. Schatz) include some smaller specimens (580, 615, 635, 640  $\mu\text{m}$ ).

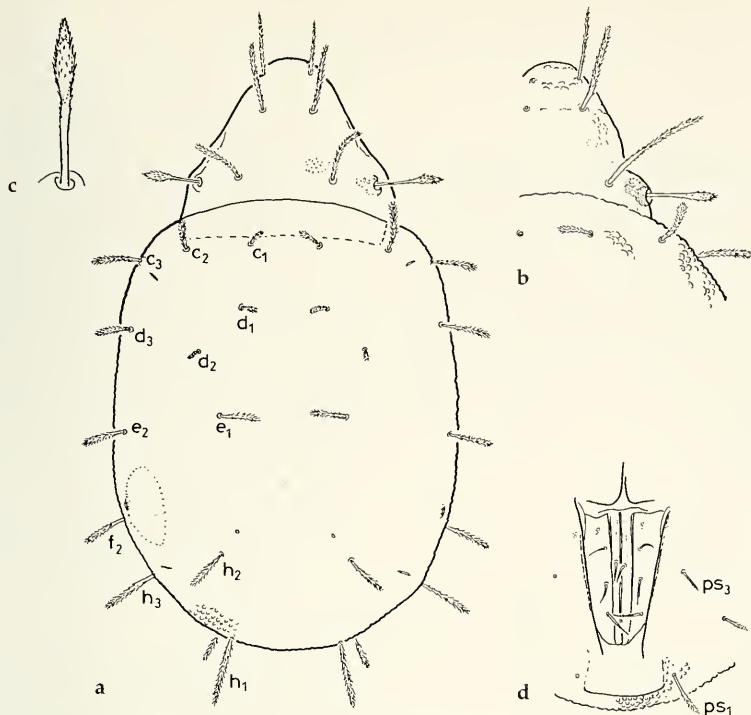


Fig. 1. *Trhypochthonius tectorum*. a. dorsal aspect (specimen from Austria). b. dorsal anterior part (Berlese coll. 23/48, Italia). c. sensillus. d. ventral aspect, anal region.

*T. septentrionalis* Fujikawa, 1995 is similar to *T. tectorum*; differences in body length, leg setation, setal shape and length are less important than reported by Fujikawa (1995), because some of her indications on *T. tectorum* cannot be confirmed. Studies on the variability of both species are needed.

*T. tectorum* is larger than the similar species *T. nigricans* and its notogastral setae ( $c_3$  and posterior setae) are longer. But there is no distinct gap between the total length variabilities of both species.

**Material studied:** 8 specimens from Berlin region, North-East Germany; 5 specimens from Austria (leg. H. Schatz); 3 specimens from West Poland (leg. P. Skubala); 1 slide in Willmann-collection, Munich (from North Germany); slides in the Berlese-collection, Florence.

**Ecology.** In dry moss cushions, scarcely in forest soils.

**Distribution.** Holarctic.

### *Trhypochthonius nigricans* Willmann, 1928

Fig. 2a

non: *T. nigricans*: sensu Seniczak & Norton (1994)

**Descriptions.** Willmann (1931), Balogh & Mahunka (1983).

This species has been studied only in microscopical slides in the Willmann-collection in Munich. The ventral characters, the subcapitulum and the legs could not be seen in detail. There were no observations in contrast to the genus characteristics above. The species is closely related to *T. tectorum*. Dorsal aspect. Smaller than *T. tectorum*, total length 525-590  $\mu\text{m}$  (after Balogh & Mahunka 1983),

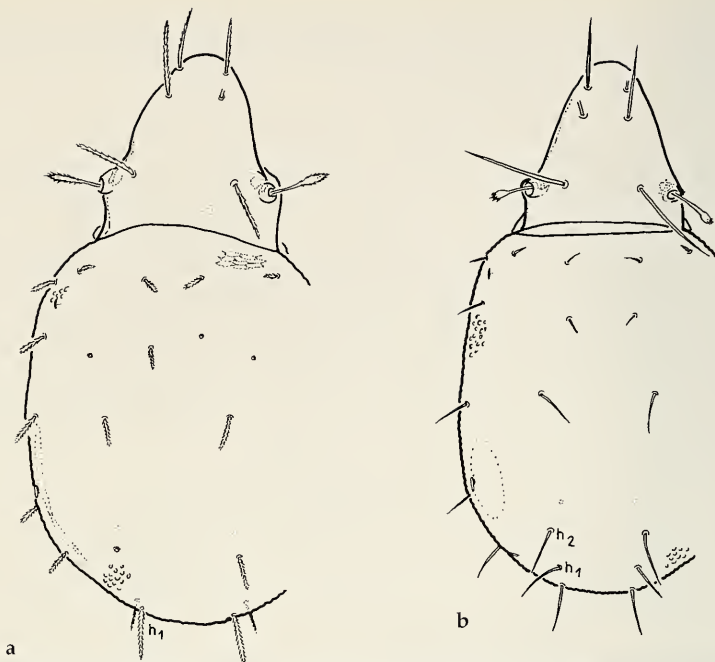


Fig. 2. a. *Trhypochthonius nigricans*, dorsal aspect (slide of Willmann coll.). b. *Trhypochthonius cladonicola*, dorsal aspect (slide of Willmann coll.).

525-550  $\mu\text{m}$  (after Willmann 1931), lectotype in Willmann-collection 570  $\mu\text{m}$  (Fig. 2a). Body shape very similar to *T. tectorum*. Prodorsum with punctated cuticula, prodorsal setae small bacilliform and ciliated (lengths of setae after lectotype specimen: *ro* about 60  $\mu\text{m}$ , *le* about 77  $\mu\text{m}$ , *in* > 65  $\mu\text{m}$ , Sensillus with fusiform head, ciliated with pointed tip, 55  $\mu\text{m}$  total length (Fig. 2a).

Notogaster in anterior region with broad netlike structure, in the other parts coarsely granulated (very similar to *T. tectorum*). Notogastral setation in number and position like in *T. tectorum*; setae not or less incrassate apically, length of *c*<sub>1</sub> about 20  $\mu\text{m}$ , *c*<sub>3</sub> about 25  $\mu\text{m}$ , *e*<sub>1</sub> and *d*<sub>3</sub> about 30  $\mu\text{m}$ ; posterior setae shorter than in *T. tectorum*: *h*<sub>1</sub> is the longest with about 50  $\mu\text{m}$ , *ps*<sub>1</sub> about 30  $\mu\text{m}$ .

The indication of Willmann (1931: p. 103; fig. 33) of a granulated prodorsum ("körnige Struktur ...") and generally of slightly arcuated dorsal setae ("Borsten... sämtlich etwas gekrümmt"), as also repeated in Balogh & Mahunka (1983) could not be confirmed by studying the lectotype specimen of the Willmann-collection.

**Discussion.** Total length with 525-590  $\mu\text{m}$  generally smaller than *T. tectorum*; lateral setae (esp. *c*<sub>3</sub>) shorter than in *T. tectorum* (< 40  $\mu\text{m}$ ), also posterior setae shorter than in *T. tectorum* (< 60  $\mu\text{m}$ ); all dorsal setae only slightly or not widened apically (in *T. tectorum* most setae appear to be widened apically). Fusiform and ciliated sensillus similar to that of *T. tectorum* (in contrast: in *T. cladonicola* and in *T. sphagnicola*, spec. nov., the sensilli have a rounded clavate head with apical spines).

**Material studied:** 4 slides in the Willmann-collection, Munich. Collected in Germany. Lectotype: Slide labelled "B 51, Büchel b. Wasserburg a./ Bodensee, 7.9.27" (South Germany, Lake Boden). Other locality: Brandmoor mire, Liebensee near Hannover (North Germany).

**Ecology.** In moss. Records by other authors must be reexamined, because of mix-up with *T. sphagnicola*, spec. nov.

**Distribution.** Germany.



*Trhypochthonius cladonicola* (Willmann, 1919)

Fig. 2b

*Camisia cladonicola* Willmann, 1919

*Trilohmannia cladonicola*: Willmann (1923)

*Trhypochthonius cladonicola*: Willmann (1931)

**Descriptions.** Willmann (1931), van der Hammen (1952), Balogh & Mahunka (1983), Seniczak (1992). *T. cladonicola* is a well known and characteristic species in Europe, the only one with smooth dorsal setae. The species has been studied only in a microscopical slide in the Willmann-collection in Munich. Only the dorsal characters could be studied with sufficient precision. The insertion point of  $d_2$  has not been seen, but it should be present.

Dorsal aspect. pale brown, total length of the drawn specimen 533  $\mu\text{m}$ ; all dorsal setae smooth and pointed. *ro* and *le* about 70  $\mu\text{m}$ , *in* about 100  $\mu\text{m}$ ; sensilli about 50  $\mu\text{m}$  with rounded head, which has apical spines. Cuticula of prodorsum punctated, cuticula of notogaster in posterior and lateral region coarsely granulated. Anterior notogastral setae 13  $\mu\text{m}$  or longer, posterior notogastral setae up to 50  $\mu\text{m}$ . opisthosomal gland dark, opening near  $f_2$ . (Fig. 2b).

Differential diagnosis. Body length 530-550  $\mu\text{m}$  (after Willmann 1931); smooth dorsal setation; head of sensillus rounded, with apical spines.

**Material studied:** 5 slides of the Willmann-collection. Collected in Germany.

**Ecology.** Moss and lichen patches, dry habitats like heather.

**Distribution.** Palaearctic.

*Trhypochthonius sphagnicola*, spec. nov.

Figs 3-5

*nigricans*: sensu Seniczak & Norton (1994)

**Note.** Some specimens of *Trhypochthonius* from a mire complex in north-eastern part of Germany (Brandenburg Country, leg. Miss Ch. Kehl) firstly were determined as *T. nigricans* Willmann, 1928 erroneously. Yet the study of *T. nigricans* in the Willmann-collection confirmed the different characters of the two species. Mainly the sensillus shape is quite different: fusiform and ciliated with a pointed tip in *T. nigricans*, clavate sensillus head with apical spines in *T. sphagnicola*, spec. nov. The bad description without any verbal characteristic of the sensillus and the poor drawings of Willmann's *T. nigricans* (Willmann 1928, 1931) did not allow to discriminate the both species. This is the reason that in Seniczak & Norton (1994) the new species (juveniles and adults) has been illustrated as "*T. nigricans*" erroneously.

**Description**

**General characters.** Total length 520-590  $\mu\text{m}$  (means 550  $\mu\text{m}$ ) long, 310  $\mu\text{m}$  broad. Colour brown, elliptical notogaster shape with more or less parallel sides in middle part.

Prodorsum. Cuticula punctated, the middle part with pavementlike rough structure; length of prodorsum about 200-220  $\mu\text{m}$ . Prodorsal setae bacilliform and ciliated, *ro* about 60  $\mu\text{m}$ , *le* about 30-35  $\mu\text{m}$ , *in* about 40-45  $\mu\text{m}$  (Figs 3a, d). Sensilli with rounded clavate head, with spines in apical part (Fig. 3b), about 40  $\mu\text{m}$  long. Exobothridial setae reduced.

Notogaster. Anterior and median part appears with netlike cuticular structure; posterior, lateral and ventral cuticula appears with coarse granulation. All 15 pairs of notogastral setae bacilliform and strongly ciliated ( $f_1$  is vestigial) (Fig. 3a). Short anterior setae (*c*, *d*) about 16-25  $\mu\text{m}$  long; longer notogastral setae (*e*, *f*, *h*) about 25-40  $\mu\text{m}$  long. opisthosomal gland near  $f_2$ . Normal numbers and positions of lyrifissures, *ia* and *ip* about 10-12  $\mu\text{m}$  long, others about 6  $\mu\text{m}$ . The lateral carina, visible in lateral view (Fig. 3d), from  $c_3$  to middle of  $e_2 - f_2$ .

Ventral region. The epimeral setae formula is 3-1-3-3 (complete setation within superfamily). The ventral border of notogaster overfolds the lateral aggenital and adanal region; posterior of the anal plates this border builds a distinct groove (as in some other *Trhypochthonius* species), which has a distinct edge, appearing as a posterior boss from dorsal view. Inside the groove the cuticular structure

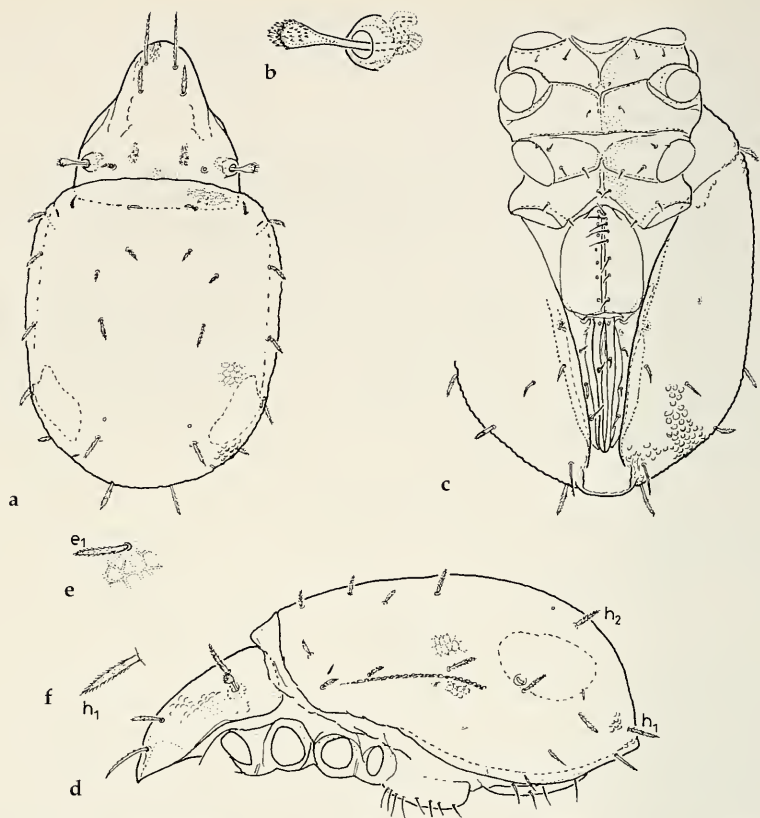


Fig. 3. *Trhypochthonius sphagnicola* spec. nov. a. dorsal aspect. b. sensillus and bothridia. c. ventral aspect, anogenital region and epimeres. d. lateral aspect. e. notogastral seta  $e_1$  and notogaster structure. f. notogastral seta  $h_1$ .

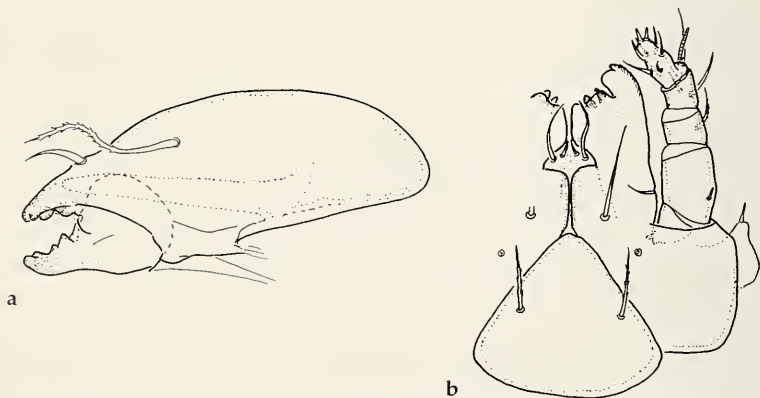


Fig. 4. *Trhypochthonius sphagnicola* spec. nov. a. chelicera. b. subcapitulum and pedipalp.

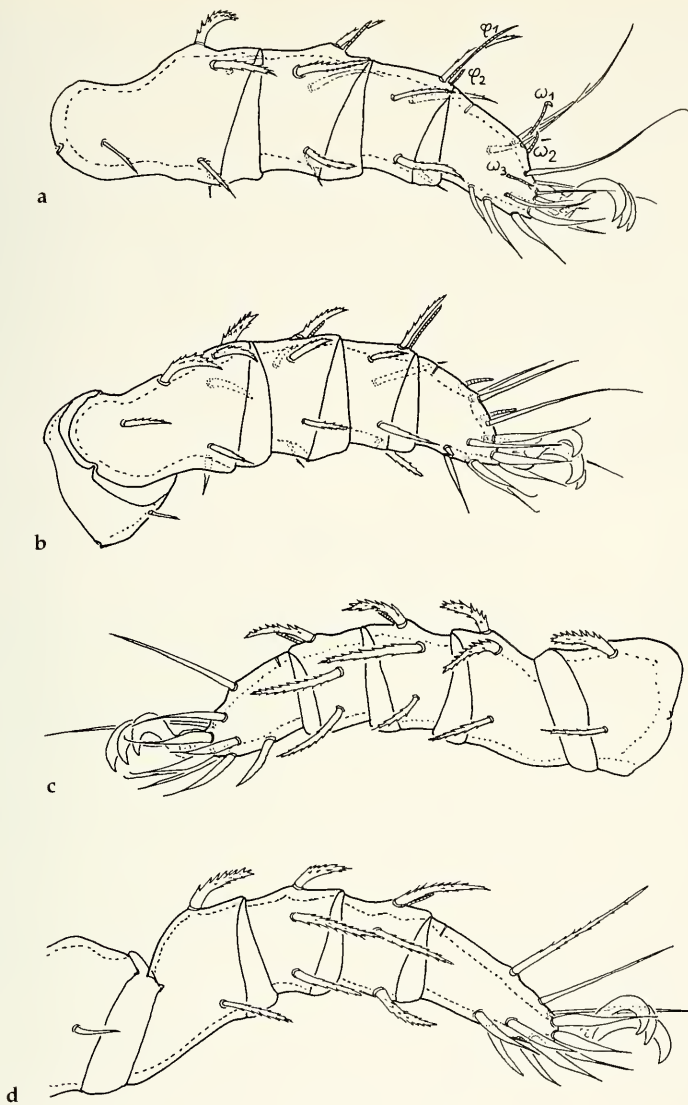


Fig. 5. *Trhypochthonius sphaenicola* spec. nov. a-d. legs I, II, III, IV.

is fine, outside coarse (Fig. 3c). The *ps*-setae are pointed and ciliated and about 20-40  $\mu\text{m}$  in length ( $ps_3 - ps_1$ ). The genital plates with a row of 8 setae each; narrow anal plates with 1 anal seta, adanal plates with 3 adanal setae each; lyrifissures *ips*, *ind* and *ian* present.

Gnathosoma. Subcapitulum stenarthric (Fig. 4b), setae *h* and *a* long, 1 pair of vestigial *m*-setae; atelebasic rutella; pedipalpal setae formula (solenidium additional in parenthesis): 0-1-1-2-9(+1), two apical setae are eupathids. Chelicers with Trägårdh's organ, about 105  $\mu\text{m}$  long; setae *cha* long, ciliated, arcuated (Fig. 4a).

Legs. Tridactylous legs with almost complete setation. As typical in the genus the ventral setae of

tarsi are long and pointed (Figs 5a-d). The setation formulas of legs are (solenids additional given in parenthesis):

leg I:	1	-	6	-	5(+1)	-	5(+2)	-	16(+3)
leg II:	1	-	7	-	5(+1)	-	5(+1)	-	13(+2)
leg III:	2	-	4	-	3(+1)	-	3(+1)	-	11
leg IV:	1	-	2	-	3	-	3(+1)	-	12

**Discussion.** *T. sphagnicola*, spec. nov., belongs to a group of *Trhypochthonius* species with strongly ciliated dorsal setae (in Middle Europe also *T. tectorum*, *T. nigricans*). In contrast the setation of *T. cladonicola* (Willmann, 1919) is smooth; the Japanese species *T. japonicus* Aoki, 1970 seems to be intermediate in this regard. *T. nigricans* has the same body length as *T. sphagnicola*, *T. tectorum* is a larger species with distinct longer dorsal setation (esp. prodorsal setae,  $c_3$ ,  $f_2$ ,  $h_1$ - $h_3$ ). The sensilli of *T. sphagnicola*, and of *T. cladonicola* have the same shape: rounded clavate head with apical spines, but in *T. tectorum* and in *T. nigricans* the sensilli are fusiform and with ciliated heads.

**Material studied:** 6 specimens from "Hecht diebel" mire in Brandenburg Country, northern Berlin (leg. Miss Ch. Kehl). Type unmounted and 1 mounted syntype deposited in Staatssammlungen Munich.

**Ecology.** In wet bogs in cushions of *Sphagnum*.

**Distribution.** Poland, Germany.

### *Altrhypochthonius* Weigmann, 1997

**Type species:** *Trhypochthonius badius* Berlese, 1905

*Trhypochthonius badius* Berlese, 1905 has some differences to the other *Trhypochthonius* species, and therefore has been placed into *Trhypochthoniellus* by some authors (van der Hammen 1959, Balogh & Mahunka 1983). But a phylogenetic analysis (Weigmann 1997a) has brought up more common characters with *Trhypochthonius* (reduced exobothridial setae, position of solenids on tarsus I) than to *Trhypochthoniellus* species (reduction of legs chaetotaxy, e.g. no setae  $v''$  on genu I and II). The special synapomorphies of *Trhypochthoniellus* and Malacostrichidae yet have not been found in *badius*, thus the leg chaetotaxy should be reduced convergently (it is not identical in detail!). The common characters of classical *Trhypochthonius* species and *badius* are regarded as characters of the family Trhypochthoniidae in a new definition (Weigmann 1997a), combining *Trhypochthonius* in a new definition with *Altrhypochthonius*.

Up to now we know only one species of *Altrhypochthonius*, *A. badius*. Therefore it is not sure which typical characters are of generic or of specific rank; the genus diagnosis is provisionally in this respect.

**Diagnosis of the genus *Altrhypochthonius*.** Differential characters (in contrast to *Trhypochthonius* s. str.): 2 anal setae; subcapitulum with 2  $m$ -setae; on tarsus I seta  $f$  reduced; setation of legs moderately reduced: e.g. genua setae formula (genua I-IV; with solenidia in parenthesis): 4(+1)-4(+1)-2(+1)-2. Notogaster of ovoid shape.

Further characters. Well developed bothridia near the lateral margin of prodorsum with well developed sensilli; no exobothridial setae present (one pair vestigial); 15 pairs of notogastral setae (incl.  $ps_3$ ); no genital neotrichy (about 6 g); 3 pairs of adanal setae; subcapitulum stenarthric; tibia I with 2 solenidia;  $w_2$  of tarsus I in median high position near  $w_1$ ; legs tridactyl.

### *Altrhypochthonius badius* (Berlese, 1905)

Figs 6-8

*Trhypochthonius badius* Berlese, 1905; Berlese 1913; Willmann 1931.

*Trhypochthoniellus badius*: Van der Hammen 1959; Balogh & Mahunka 1983.

*Altrhypochthonius badius*: Weigmann 1997a.

**Redescription.** The detailed redescription of the species by using fresh specimens from Germany has been confirmed in respect to important diagnostic characters (body size; dorsal and ventral setation,



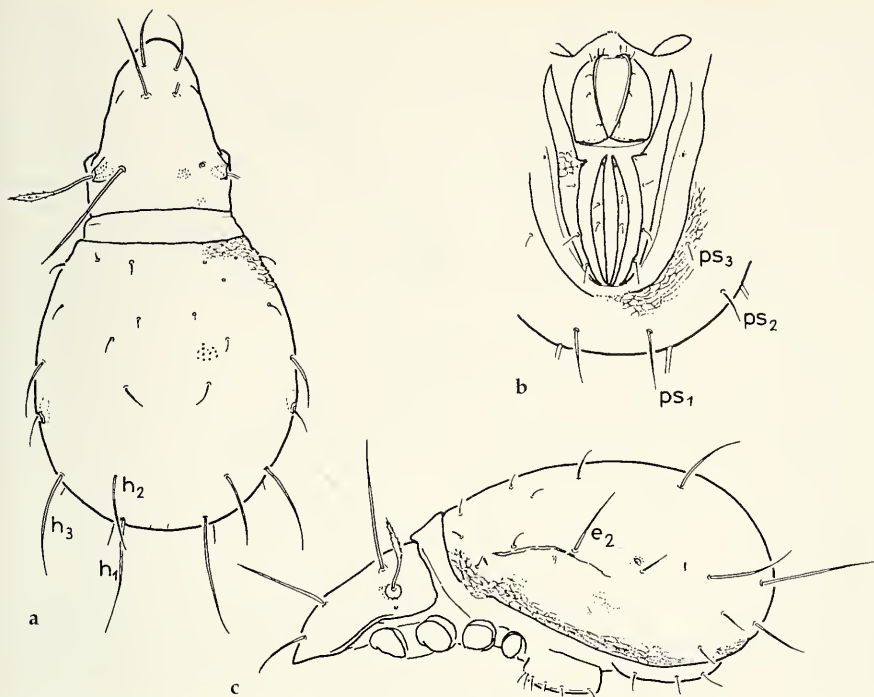


Fig. 6. *Altrhyppochthonius badius*. a. dorsal aspect. b. ventral aspect, anogenital region. c. lateral aspect.

as e. g. 2 anal setae; leg I setation; stenarthric subcapitulum with 2 *m*-setae; 6 genital setae) by studying Berlese's slides. Also the specimens in the Willmann-collection show no differences.

General characters. Total length 500-560  $\mu\text{m}$ , ovoid notogaster shape. Colour pale to chestnut brown.

Prodorsum. Cuticula punctated; length of prodorsum about 175-200  $\mu\text{m}$ . Prodorsal setae glabrous and setiform, *ro* about 60  $\mu\text{m}$ , *le* about 60-100  $\mu\text{m}$ , *in* about 140  $\mu\text{m}$ . Sensillus long, about 90-120  $\mu\text{m}$ , with small fusiform and spiculated head. Exobothridial seta vestigial. (Figs 6a, c).

Notogaster. Anterior and lateral parts with netlike coriaceous structure, middle parts coarsely punctated. 15 pairs of notogastral setae, partly very short ( $c_1$ - $c_3$ ,  $d_1$ - $d_3$ ) about 3-15  $\mu\text{m}$ , partly of middle size ( $e_1$ ,  $f_2$ ,  $ps_2$ ,  $ps_3$ ) about 30-40  $\mu\text{m}$  long; four pairs of setae strong and long,  $e_2$  about 80  $\mu\text{m}$ ,  $h_2$  about 80-100  $\mu\text{m}$ ,  $h_1$  about 100-150  $\mu\text{m}$ ,  $h_3$  about 100  $\mu\text{m}$ . Opisthosomal gland near  $f_2$ . Normal numbers and positions of lyrifissures, *ia* near  $c_3$ . The lateral carina extends from behind  $c_3$  to the middle of the body. (Figs 6a, c).

Ventral region. The epimeral setae formula is 3-1-3-2 (*4a* is missing). The typical longitudinal groove of notogaster behind the anal plates, as in *Trhyppochthonius*-species, is not visible, but the posterior border line of notogaster indistinct (this character might depend on swollen or shrunk notogaster by preparation).  $ps_3$  is the shortest of the *ps*-setae (Fig. 6b). Genital plates with 6 setae, anal plates with two anal setae, adanal plates (fused with aggenital plates?) with 3 adanal setae; lyrifissures *ips*, *iad* and *ian* present.

Gnathosoma. Subcapitulum stenarthric, setae *h* and *a* long, 2 short *m*-setae, atelebasic rutella (Fig. 7a). Pedipalpal setae formula normal as in the family: 0-1-1-2-9(+1); two apical setae are eupathids. Chelicers (Fig. 7b) about 120  $\mu\text{m}$  long with Trägård's organ, setae *cha* long, ciliated; with two accessory dents on digitus fixus.

Legs. Tridactylous legs (Figs 8a-d) with moderately reduced setation (compared with *Trhyppochthonius* species). The setation formulas of legs are (solenids additional given in parenthesis):

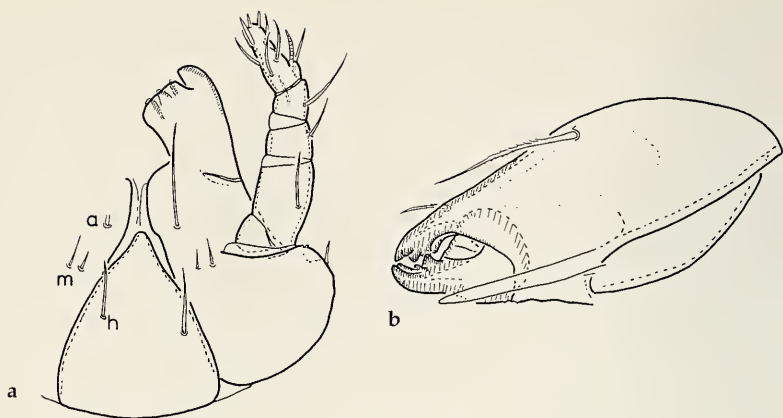


Fig. 7. *Altrhyopchthonius badius*. a. subcapitulum and pedipalp. b. chelicera.

leg I:	1	-	6	-	4(+1)	-	5(+2)	-	15(+3)
leg II:	1	-	7	-	4(+1)	-	4(+1)	-	13(+2)
leg III:	2	-	3	-	2(+1)	-	2(+1)	-	12
leg IV:	1	-	2	-	2	-	2(+1)	-	13

**Material studied:** Some slides in Berlese-collection in Florence, studied 1995: slide "29/1 *Tripochthonius badius* n. sp. Firenze sfagno" (3 specimens, lectotype specimen, selected by this paper shall be the specimen in the most upper-right position); slides 29/2-5 *T. badius*, from same locality; 2 slides of the Willmann-collection in Munich, studied 1993, collected in "Zehlau Bruch" 1919, West Russia; Material from North-East Germany, collected by Mrs. Christine Kehl in a bog "Hechtdiebel" north of Berlin in Brandenburg Country (7 specimens studied). 1 specimen deposited in the Staatssammlungen Munich.

**Ecology.** In wet bogs, mainly in *Sphagnum* cushions.

**Distribution.** Europe (Italy, Poland, Russia, Germany).

### *Mucronothrus* Trägårdh, 1931

**Type species:** *Mucronothrus rostratus* Trägårdh, 1931; syn. of *M. nasalis* (Willmann, 1929)

**Diagnosis of the genus.** Large *Trhyopchthonius*-like body shape; pale yellow; anterior part of rostrum forms a noselike tip, bearing the rostral setae; bothridium open, funnellike, in the base of which a setiform sensillus is inserted; legs monodactyl; genital neotrichy (11-22 genital setae); 2 adanal setae, 2 anal setae normally. Reduced leg setation (e.g. setal-solenidial formula of genua of legs I - IV: 4(+1)-4(+1)-3(+1)-3(+0)).

### *Mucronothrus nasalis* (Willmann, 1929)

Figs 9-10

*Malaconothrus nasalis* (Willmann, 1929)

*Mucronothrus nasalis*: Willmann (1931)

*Mucronothrus rostratus* Trägårdh, 1931

**Descriptions.** Willmann (1929, 1933), Trägårdh (1931), Hammer (1958, 1966), Travé (1973), Balogh & Mahunka (1983), Norton et al. (1996).

**General characters.** Total length 580-800  $\mu\text{m}$  (maximal width about 300  $\mu\text{m}$  at a specimen of 670  $\mu\text{m}$  length) more or less flattened body; colour pale yellow, structure of cuticula on prodorsum punctulated, on notogaster reticulated to coarsely granulated; all setae smooth. (the following measurements of

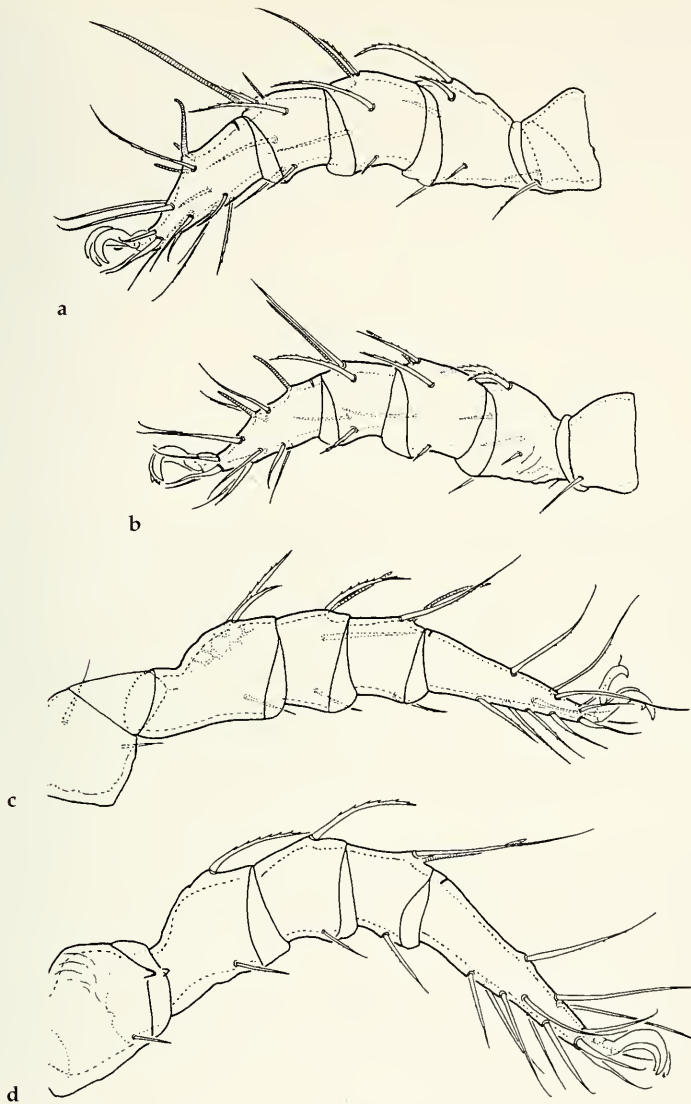


Fig. 8. *Altrhypochthonius badius*. a-d. legs I, II, III, IV.

setation after the figured specimen with 670  $\mu\text{m}$  length from Pyrenean Mountains).

Prodorsum. Length about 250  $\mu\text{m}$ . Anterior part nasiform, narrow, bent downwards (Figs 9a, e); two (in seldom cases three: cp. Willmann 1933) rostral setae of about 100  $\mu\text{m}$ , bent sideways; sides of prodorsum at the leg I-leg II region rounded; lamellar setae about 160  $\mu\text{m}$  long and close together; interlamellar setae about 260  $\mu\text{m}$  long; anterior exobothridial setae about 15  $\mu\text{m}$ , posterior *ex* vestigial; sensilli setiform, about 35  $\mu\text{m}$  length in an open funnellike bothridium formed like a normal seta, without bothridial basal apparatus (Figs 9b, c); sometimes with visible median maculae between interlamellar setae.

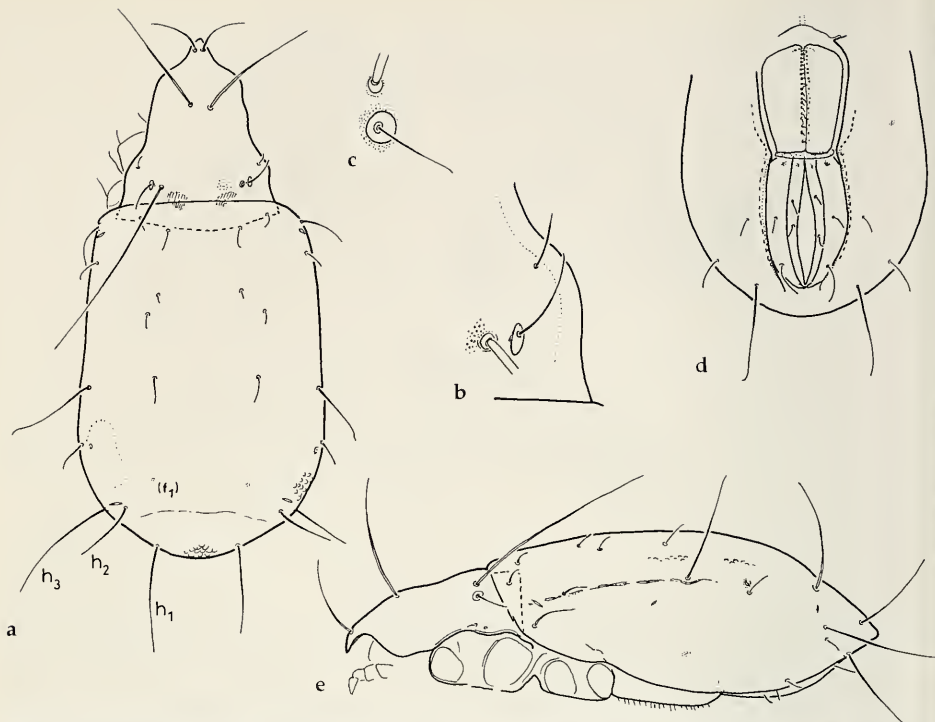


Fig. 9. *Mucronothrus nasalis*. a. dorsal aspect. b. part of prodorsum with sensillobothridial complex enlarged, dorsal view. c. dto, dorsolateral view. d. ventral aspect, anogenital region. e. lateral aspect.

**Notogaster.** In dorsal view shape nearly parallel-sided to conical, broadest part at setae  $f_2$ ; with moderately developed lateral carina, to be seen in lateral view, reaching from  $ia$  in front to  $e_2$ ; 15 notogastral setae;  $f_1$  vestigial; most notogastral setae short ( $c_1, c_2, d_1-d_3, f_2, ps_2, ps_3$  about 20-30  $\mu\text{m}$ ), some of medium length ( $c_3$ : 60  $\mu\text{m}$ ,  $e_1$ : 33  $\mu\text{m}$ ) and the other notogastral setae long ( $e_2, h_2, h_3$  about 140-150  $\mu\text{m}$ ,  $h_1, ps_1$  about 125  $\mu\text{m}$ ). Setae  $h_1$  inserted much more backwards than  $h_2$  and  $h_3$ . Five pairs of lyrifissures present,  $ia$  larger than the others; opisthosomal gland pore near  $f_2$ . (Figs 9a, e).

**Ventral region.** Epimeral setal formula is 3-1-2-2 (3a and 4a missing; in one case at one side an additional 2b); all epimeres are medially fused; the notogastral frame close to genital and adanal plates, at the posterior part behind anal plates with a flat groove (as in *Trhypochthonius*); genital plates with one row of 18-20 setae each (some populations out of Europe with higher variability of the genital neotrichy, 13-22 g; see Travé 1973); no aggenital plates and setae; 2 pairs of adanal setae, 2 pairs of anal setae,  $iad$  and  $iam$  present. (Fig. 9d).

**Gnathosoma.** Subcapitulum stenarthric (Fig. 10a), setae  $h$  short, 1 pair of setae  $m$ , setae  $a$  long (about 24  $\mu\text{m}$ ); adoral setae strong with furcated tip; rutellum of atelabasic type; palp with setation 0-1-1-2-8(+1). Chelicera (Fig. 10b) robust and short (130  $\mu\text{m}$ ) with Trägårdh's organ, with two setae ( $cha$  short) and four accessory dents on digitus fixus.

**Legs.** Setation is very variable (see Travé 1973) and compared with *Trhypochthonius* reduced (some setae vestigial or facultatively expressed); "normal" setation formulas of legs (solenidia not included and given in parenthesis):

leg I:	1	-	5	-	4(+1)	-	4(+1)	-	13 (+3)
leg II:	1	-	5	-	4(+1)	-	4(+1)	-	12 (+2)
leg III:	2	-	3	-	3(+1)	-	3(+1)	-	10
leg IV:	1	-	3	-	3	-	3(+1)	-	10

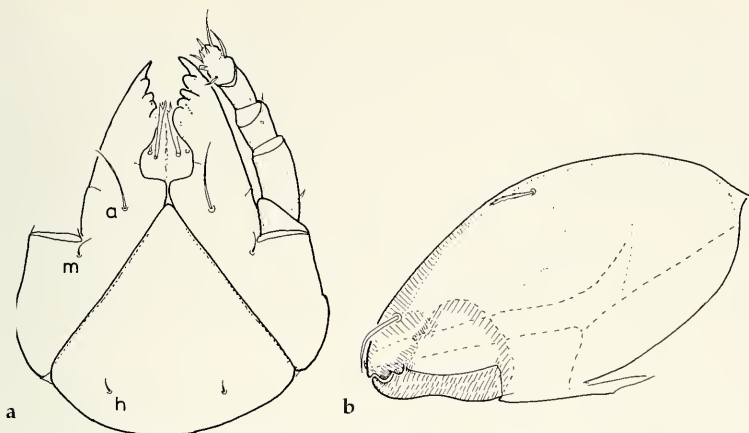


Fig. 10. *Mucronothrus nasalis*. a. subcapitulum and pedipalp. b. chelicera.

**Discussion of phylogenetic relationships.** *Mucronothrus* is a member of Malaconothroidea (lyrifissure *in* relatively large; without aggenital plates: cp. Knülle 1957, Haumann 1991, Weigmann 1997a). Special characters within the superfamily are the noselike rostral tip, the sensillo-bothridial complex and the genital neutrichy (the last being convergent also in *Trhypochthoniellus*).

The leg setation is reduced and points to a relation to Trhypochthoniellidae and Malaconothridae (in contrast to Trhypochthoniidae). That was why Travé (1973) discussed the membership of *Mucronothrus* to Trhypochthoniellidae sensu Knülle (1957). Special similarities are:  $w_2$  on Tarsus I in an anterior low position near  $w_3$ , tibia I only with 1 solenidium, ventral setation of tibiae short and thicker than others (however with pointed tip in *Mucronothrus*) leg setation at all reduced. A plesiomorphic character within the superfamily is the vestigial second exobothridial setae. *Mucronothrus* does not fit into one of the families mentioned, thus must be regarded as a distinct family Mucronothridae Kunst, 1971 (Weigmann 1997a).

After finishing this redescription I have got the description of the north american *M. nasalis* and a second species of *Mucronothrus*, *M. willmanni* Norton et al., 1996. There are no relevant differences of the american populations in contrast to the european with regard to the species characteristics given above. *M. willmanni* is characterized mainly by a narrower rostral mucro ("nose"), epimeres III and IV are medially separated by soft cuticle in adults also, the leg setation is more regressive than in *M. nasalis*.

The presented chaetotaxy of notogastral setae differs from those of some authors (cp. Fujikawa 1995, Norton et al. 1996) in regard of the *h*- and *ps*-rows. By comparing different Malaconothroidea species it seems to be most probable, that setae  $h_1$  are inserted much more backwards than  $h_2$  and  $h_3$ , as in some other species  $f_1$  compared with  $f_2$ ; the *ps*-row is situated at the ventral side more or less parallel to adanal plates, and *ps*-setae are shaped differently from *h*-setae sometimes.

**Material studied:** 5 specimens from Pyrenean Mountains (leg. J. Travé), 4 specimens from Altvater Mountains, Czechia in the collection of Museum für Naturkunde, Görlitz (leg. H.-D. Engelmann). Compared with specimens from North America (leg. R. Norton).

**Ecology.** In moss of wet mountain habitats and wet subarctic habitats.

**Distribution.** Worldwide (in northern Europe, in Austria, Czechia, Pyrenean Mountains; eastern Palaearctic and Nearctic; South America, New Zealand).



**Type species:** *Trhypochthoniellus setosus* Willmann, 1928; syn. of *T. longisetus* (Berlese, 1904)

The genus was described as a new subgenus *Thrypochthonius* (*Thrypochthoniellus*) (both wrong spelled as a lapsus) by Willmann (1928) for the new species *T. setosus* Willmann, 1928. The only mentioned discriminating character against *Trhypochthonius* s. str. is the lack of bothridia and sensilli. In Willmann (1931) *Trhypochthoniellus setosus* is mentioned as the single species of the genus *Trhypochthoniellus*.

Grandjean (1939) found the reduced leg setation of *T. setosus* and *Trhypochthonius excavatus* Willmann, 1919 being identical, and he based the genus *Trhypochthoniellus* on the leg setation consequently, though *T. excavatus* has well expressed bothridia and sensilli and *T. setosus* does not have both. In that paper Grandjean discussed the trichobothridial regression in the ontogeny from larvae to adults in Camisiidae, Malaconothridae, *Trhypochthoniellus* and other genera, and he pointed out that the presence or absence of the trichobothridial complex is of minor importance for the genus taxonomy, especially for *Trhypochthoniellus*.

Subsequent authors accepted Grandjean's conception of the holarctic genus. For instance in Balogh & Mahunka (1983) *Trhypochthoniellus* includes *T. setosus*, *T. longisetus* (Berlese, 1904), *T. excavatus*, *T. trichosus* (Schweizer, 1922) besides *T. badius* (the latter erroneously, as discussed above).

According to Knülle (1957) *Trhypochthoniellus* has a systematic position near Malaconothridae, in a distant position to *Trhypochthoniidae* (cp. Weigmann 1996, 1997a) and thus a distinct family *Trhypochthoniellidae* Knülle, 1957 must be accepted. Apomorphies of this family are the following characters: diarthric subcapitulum (anarthry in Malaconothridae, stenarthry in *Trhypochthoniidae* and *Mucronothridae*), notogastral setae  $ps_3$  reduced (present in all other Malaconothroidea). The family includes only one genus up to now.

The present study of *Trhypochthoniellus* is based on the type series of *T. longisetus* (Berlese, 1904) (deposed in Florence), on slides with *T. setosus* Willmann, 1928 and "*T. trichosus*" from the Willmann-collection in Munich, on fresh material from Northern Germany, determined as *T. setosus*, and on fresh material from Northern Germany, at first determined as *T. trichosus* (Schweizer, 1922).

German specimens of "*setosus*" have been collected in the same samples than some of the "*trichosus*" specimens. A morphological analysis of variability and biometric correlations within the northern german "populations" in geographical separation led to the result that there are distinct strains of the obligatorily parthenogenetic *Trhypochthoniellus* subpopulations (Weigmann 1997b). Within two subpopulations from two localities there is a graduated regression of the trichobothridial complex, a high number of asymmetric differences (one side with sensillus, one side without; see fig. 12) and no strict combination with other morphometric parameters to absence or presence of the trichobothridial complex. As a result of this analysis the different subpopulations must be regarded of subspecific status of one species. Because of the obligatory thelytokous parthenogenesis the syndtopic and allotopic subpopulations are regarded as genetically independent clones of one species.

But there might be also ecological differences between morphologically different clones. Therefore an intrasubspecific differentiation of a "forma typica" with developed trichobothridial complex and a "forma *setosus*" without this complex seems to be reasonable and is proposed in the following.

Our specimens, determined as *T. trichosus* (Schweizer, 1922), have been found conspecific with *T. longisetus* (Berlese, 1904) after studying Berlese's type material. *T. trichosus* is a junior synonym as will be discussed below.

Following this argumentation there is only one european *Trhypochthoniellus* species with two intrasubspecific taxa, i.e. two forms.

### *Trhypochthoniellus longisetus* (Berlese, 1904) forma typica

Figs 11-12

*Trhypochthonius longisetus* Berlese, 1904

*Trhypochthoniellus longisetus*: Balogh & Mahunka 1983

*Tripochthonius trichosus* Schweizer, 1922: (syn. nov.); Willmann 1931

*Trhypochthoniellus trichosus*: Balogh & Mahunka 1983

*Camisia excavata* Willmann, 1919 (syn. nov.)

*Trhypochthonius excavatus*: Willmann 1931

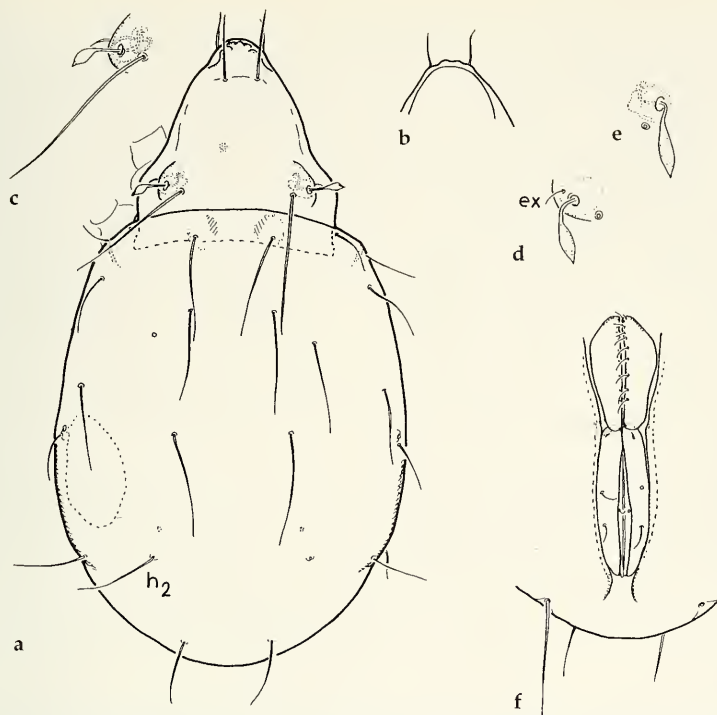


Fig. 11. *Trhypochthoniellus longisetus* forma typica, from slides of Berlese's type material. a. dorsal aspect. b. rostral line in ventral view. c-e. trichobothridial complex of different specimens. f. ventral aspect, anogenital region.

*Trhypochthoniellus excavatus*: Grandjean 1939; Balogh & Mahunka 1983

? *Nothirus crassus* Warburton & Pearce, 1905

*Trhypochthonius crassus*: redescribed by Luxton (1987) (assumed syn. nov.)

**Descriptions.** See list of synonyms

**General characters.** Total length 460-580  $\mu\text{m}$  (mean 520  $\mu\text{m}$ ,  $n = 55$ ); cuticula pale brown; opisthosomal gland large, obviously darker or not. In the posteriolateral region sometimes the contour is slightly incised (at  $h_3$  and at  $ps_2$  position; see figs 12a, b). (Following measures referred to specimens of middle size).

**Prodorsum.** Cuticula punctated; at the anterior part of the rostrum there are 4-5 humps causing a more or less undulated frontal border line (Figs 11a-b, 12a); dorsal setae smooth,  $ro$  about 30-40  $\mu\text{m}$ ,  $le$  about 50-70  $\mu\text{m}$ ,  $in$  about 100-130  $\mu\text{m}$  (in Berlese's type 108  $\mu\text{m}$ ); sensillus (Figs 11a, c-e) with thick fusiform, smooth head, tip acutely pointed, about 30-40  $\mu\text{m}$  long; exobothridial seta  $ex$  about 20  $\mu\text{m}$ , inserted near to bothridia; at the border of the prodorsum besides  $ex$  there is a more or less distinct vestigium of a second exobothridial seta (?). (Figs 11a, 12a).

**Notogaster.** Coriaceous structure; in anterior, lateral and ventral region partly netlike, in the middle and posterior region appearing coarsely pustulated (Figs 11a, 12a). 14 smooth notogastral setae, mostly long (about 70-90  $\mu\text{m}$ ),  $c_2$  is the shortest (about 30-40  $\mu\text{m}$ );  $ps_3$  totally missing,  $f_1$  mostly vestigial or missing. Opisthosomal gland near  $f_2$ ; lyrifissures  $ia$  and  $ip$  large, others small; lateral carina of notogaster reaching from  $ia$  to  $ps_2$ .

**Ventral region.** Epimeral setal formula is 3-1-3-2; ventral border of notogaster scarcely overfolding genital and anal region, between both regions with a toothlike extension, bearing the lyrifissure  $ips$ ; behind anal region with a longitudinal flat groove (as in *Trhypochthonius* species). 10-14 pairs of genital

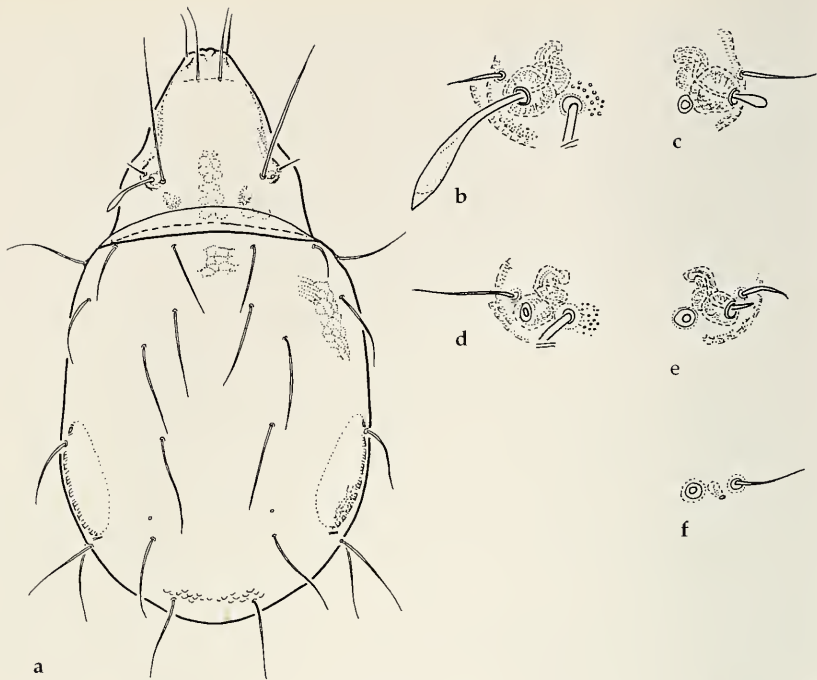


Fig. 12. *Trhypochthoniellus longisetus* from North East Germany. a. dorsal aspect of an asymmetric specimen (right sensillus reduced). b. left trichobothridial complex of an asymmetric specimen. c. right trichobothridial complex of the same specimen. d. left trichobothridial complex of an asymmetric specimen, sensillus reduced. e. right trichobothridial complex of the same specimen, sensillus as short seta. f. right trichobothridial complex of another specimen, trichobothridial complex extremely reduced.

setae (often with asymmetric numbers) in median rows; 1 anal seta, 2 adanal setae. Normal pattern of lyrifissures: *ips, iad, ian*. (Fig. 11f).

Gnathosoma. Subcapitulum diarthric, the oblique sutures of the borders of the hypostomal plate (sternit of pedipalp segment) are visible, the plate is fused with the base of the palps (cp. fig. 14a). Seta *h* short, seta *m* in the articulation also short; rutellum of atelebasic type; palpal setation (solenidium in parenthesis): 0-1-1-1-9(+1); two setae on palp tarsus are eupathids.

The chelicera (cp. fig. 14b) is about 100  $\mu\text{m}$  long, with Trägårdh's organ.

Legs. Tridactylous (as in figs 15a-d), with reduced leg setation (compared with *Trhypochthonius*). The ventral setae of tarsus, tibia and genu short, thick and mostly glabrous (similar some further distal setae on tarsus). The setation formulas of the legs are (solenids additional given in parenthesis):

leg I:	1	-	6	-	3(+1)	-	4(+1)	-	12(+3)
leg II:	1	-	5	-	3(+1)	-	3(+1)	-	11(+2)
leg III:	2	-	2	-	2(+1)	-	2(+1)	-	10
leg IV:	1	-	2	-	2	-	2(+1)	-	11

**Discussion.** The figure 44 on *T. longisetus* in Berlese (1904) shows very short setae *in*, which led to the description of *T. trichosus* Schweizer, 1922. Schweizer mentioned this fact (*in* about 110  $\mu\text{m}$ ) and declared the similarity to *T. longisetus*, but he did not mention *T. excavatus*. But the drawing of Berlese is wrong obviously: all specimens in the slides of Berlese show very long interlamellar setae. Therefore the key of Balogh & Mahunka (1983 p. 197) reports a mistake also ("interlamellar setae minute" in *T. longisetus*). There have been found no considerable differences between *T. longisetus* original spec-

imens and northern german specimens, which had been determined as *T. trichosus* earlier. *T. trichosus* Schweizer, 1922 thus must be regarded as a junior synonym.

*T. excavatus* (Willmann, 1919) is described very poorly (including also the description in Willmann (1931), where the author expressed doubts regarding the separation of *excavatus* and *trichosus* as two good species). The differentiation of both species in the key of Willmann (1931) is not based on serious characters (position of bothridia and opisthosomal glands, shape of sensilli). The length of the notogastral setae ( $c_1$ ,  $d_1$  and others) has been drawn very short in Willmann's figure (1919); but this character has a high variability and is of doubtful worth to discriminate two species as done in the key of Balogh & Mahunka (1983: p. 197). In Willmann's collection of slides in Munich there was useful material for a reliable comparison of *T. excavatus*. Whithin 19 specimens in 9 slides from different localities 3 specimens show asymmetry with partly or totally regressed sensilli, comparable with northern german specimens (cp. fig. 12); the other specimens have typical sensilli (cp. fig. 11). Some of the slides show specimens with rather long notogastral setae; *T. excavatus* is a junior synonym of *T. longisetus*, very probably.

Luxton (1987) redescribed *Nothrus crassus* Warburton & Pearce, 1905 as *Trhypochthonius crassus*. Without doubts it is a *Trhypochthoniellus* species: 14 smooth and long notogastral setae ( $c_2$  short); exobothridial setae near bothridia; pointed glabrous head of a fusiform sensillus. If the indication of three pairs of adanal setae should be an error, there is no reason that *T. crassus* is not a synonym to *T. longisetus* also.

**Material studied:** Type material of Berlese-collection in Florence: Slide 23/49 "*Trhypochthonius longisetus* n. sp., serre cascine, Firenze" (with 3 specimens; lectotype shall be the specimen in the right upper corner). Slides 71/37, 71/37 bis; Slides of the Willmann-collection in Munich, labelled *T. trichosus* or *T. excavatus*; 58 specimens from North-East Germany (leg. Mrs. Christine Kehl): in a *Sphagnum* bog, "Hechtdiebel" mire north of Berlin in Brandenburg Country; "Hundekehle Fenn" mire in Berlin; "Postfenn" mire in Berlin.

**Ecology.** In wet mires, mainly in *Sphagnum* cushions.

**Distribution.** Worldwide (Palaeartic, North and South America, New Zealand).

### *Trhypochthoniellus longisetus* forma *setosus* Willmann 1928 Figs 13-15

*Trhypochthoniellus setosus* Willmann, 1928.; Willmann 1931; Balogh & Mahunka 1983.

In the morphometric analysis of "*T. longisetus* forma typica" and "forma *setosus*" mentioned above (Weigmann 1997b) all details of both forms have been studied likewise. Besides of variable morphometric details without taxonomical worth only the expression of the trichobothridial complex has been found to differentiate the both forms. The specimens without bothridia and sensilli (Fig. 13a), described as *T. setosus* Willmann, 1928, will be regarded as "forma *setosus*" in its normal appearance. But detailed studies in a larger population, which was syntopic with *T. longisetus* forma typica (with fully expressed trichobothridial complex) brought a good number of intermediate specimens in regard to the bothridia and sensilli, some of them being asymmetric (Figs 12a-f). This is the main reason to bring together both forms with gradually "regressed" trichobothridial complex (compare Grandjean 1939) as a single species. Because of the identical morphology of notogaster, ventral region, gnathosoma and legs (Figs 13-15) most of these details have not been illustrated twice in this paper. One of the morphometric differences of both forms is the total body length: The range of *T. longisetus* forma *setosus* was 435-500  $\mu\text{m}$  (mean 465  $\mu\text{m}$ ,  $n = 24$ ), this is smaller than the means of the forma typica. Other parameters (setal length and distances) are in similar ranges.

**Material studied:** Willmann-collection in Munich, 1 slide labelled "*Trhypochthoniellus setosus*, M 63, Riedschatten, April 26" (locality unclear); 24 specimens from North-East Germany (leg. Mrs. Christine Kehl): in a *Sphagnum* bog, "Hechtdiebel" mire north of Berlin in Brandenburg Country.

**Ecology.** In wet mires, mainly in *Sphagnum* cushions.

**Distribution.** Holarctic.



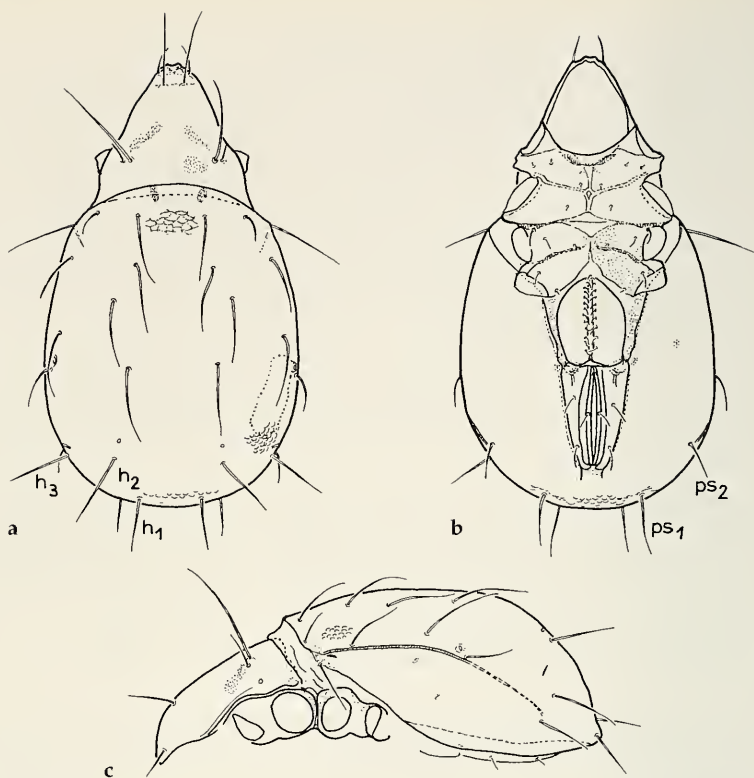


Fig. 13. *Trhypochthoniellus longisetus* forma *setosus*, from North East Germany. a. dorsal aspect. b. ventral aspect. c. lateral aspect.

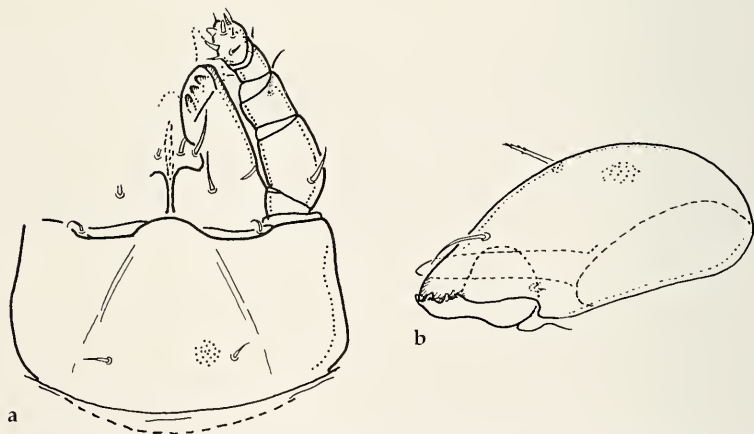


Fig. 14. *Trhypochthoniellus longisetus* forma *setosus*, from North East Germany. a. subcapitulum and pedipalp. b. chelicera.



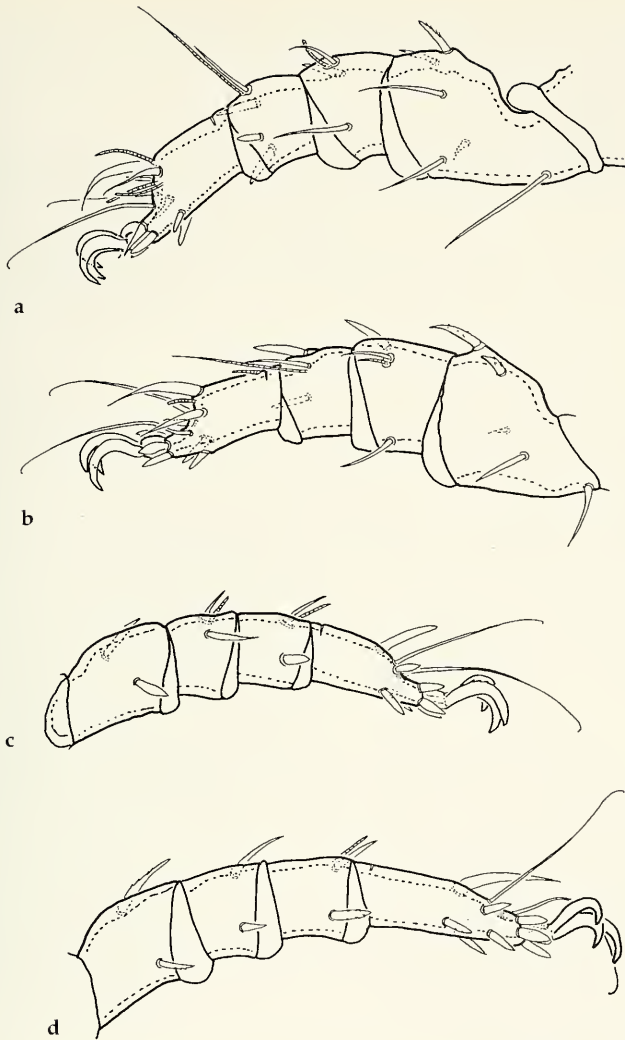


Fig. 15. *Trhypochthoniellus longisetus* forma *setosus*, from North East Germany. a-d. legs I, II, III, IV.

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